CONSTRUCTION SPECIFICATION

NV-23A. BENTONITE TREATED EARTHFILL

1. SCOPE

This item shall consist of furnishing bentonite, mixing bentonite with soil and placing bentonite-treated soil.

2. MATERIALS

The bentonite shall be a free flowing, high swelling, granular sodium bentonite. Bentonite in fine powder form shall not be used due to loss from blowing dust. Bentonite shall be Envirogel 10 as manufactured by Wyo-Ben Inc. or Granular Bentonite 12/40 mesh manufactured by Black Hills Bentonite or equivalent. The bentonite shall have a free swell of at least 18 cc/2gm as measured by ASTM Standard Test Method D 5890 and shall meet the following gradation requirements:

Sieve Size	Percent Passing
10	98-100
20	60-100
200	0-20

3. APPLICATION

Bentonite shall be applied only on relatively calm days to prevent significant loss of material. Bentonite shall be applied to soil that is free of all vegetation, trash, roots, frozen soil, snow, ice, stones over two (2) inches in diameter, and other objectionable material. Surfaces shall be graded to remove irregularities and thoroughly tilled if necessary to reduce the soil to its native particle size.

Bentonite shall be spread uniformly at the specified application rate measured in pounds of bentonite per square foot of surface area per lift thickness. The amount of bentonite per lift and the number of lifts shall be as shown on the drawings or specifications.

The bentonite shall be uniformly spread on the surface using a truck drawn spreader box, agriculture lime spreader, mechanized conveyor-fed material spreader box or other type of drop spreader approved by the engineer or technician. Broadcast spreaders are not acceptable. Pre-measured tarpaulins or cloths placed in different locations shall be weighed after spreading material to verify that the specified application rate is met.

The bentonite may also be applied at the specified rate by distributing 100-pound bags of material in a marked grid pattern. Each bag shall be opened and the material spread evenly within each grid square, using hand rakes.

4. MIXING

Bentonite shall be thoroughly mixed with a rototiller, soil stabilizer or other similar mixing equipment approved by the Technician. Small or medium sized tractor drawn rototillers are acceptable but self-propelled industrial rototillers are preferred. The rototiller shall be capable of digging to a depth at least equal to one compacted lift thickness. A minimum of two passes of the mixer shall be used. For the first pass set the mixing depth to approximately ½ of the full lift depth, then reset the mixer to full depth for the second pass. The speed of the mixer shall be adjusted to insure complete and uniform mixing of the materials. Bentonite may be incorporated with stockpiled material and then placed in the desired area or incorporated with material in place, such as the sides and bottom of the pit.

To yield sufficient water content, bentonite shall be applied and mixed with a relatively dry soil, then watered, re-mixed and compacted. In certain instances it may be necessary to wet the soil previous to applying the bentonite to prevent the bentonite from “balling up”. Conversely, it may be necessary to dry the soil to achieve the recommended moisture content. Practice runs are recommended with unfamiliar material to find the most desirable application mixing/(de)watering and re-mixing process.

A plant or pugmill type mixer may be used to produce the required soil-bentonite mixture as specified. Heavy silts or clay type materials shall pass through a soil pulverizer or hammermill to precondition the soil prior to introduction into the mixing chamber. The mixed soil bentonite material produced by a plant mixing system shall be directly transported to the job site and placed immediately to minimize moisture loss.

5. COMPACTION

The thickness of the finished compacted bentonite treated earth fill blanket or individual lifts shall be as shown in the drawings or specifications.

Unless otherwise specified the thickness of each lift shall be a maximum of nine (9) inches to be compacted to a layer approximately six (6) inches thick.

When multiple lifts are specified or required, the interface between the lifts shall be roughened or scarified a minimum of ½ inch prior to placement of the next lift.

Compaction adjacent to structures protruding through the soil bentonite mixture shall be compacted to a density equivalent to that of the surrounding mixture by means of manually directed power tampers or plate vibrators.

Unless otherwise specified, a protective cover layer of at least 12 inches of on-site material shall be applied immediately after compaction, over the bentonite treated earth fill blanket to protect it from forming drying cracks and from weathering.

Bentonite treated earth fill soil shall have a water content sufficient to insure compaction. When kneaded in the hand, it will form a ball, which does not readily separate when struck sharply with a pencil, and will not extrude out of the hand when squeezed tightly. Water should be added to the soil (or dried out if too wet) before applying bentonite to yield a sufficient water content.

Compaction with a sheepsfoot roller or tamping type of roller shall not be allowed.

Each lift shall be compacted by traversing the entire surface with not less than two passes of a pneumatic-tired roller exerting a pressure of not less than 50 pounds per square inch. A flat steel wheel roller exerting not less than 100 pounds per inch of width of roller, or a vibrating compactor may also be utilized on non-cohesive soils. Partially penetrating pad foot compactors, such as those found on landfill compactors, may be used on cohesive material or other suitable equipment approved by the Technician may also be used.

An alternative to heavy compaction equipment is traversing the entire surface with a wheel type tractor (minimum 100 horsepower) with not less than five passes. The lift thickness shall be reduced by one half of the specified thickness if the total thickness of the blanket or lift is more than five (5) inches. Tractors must exert a pressure of not less than 10 pounds per square inch.

The methods of compaction described above are intended to achieve 90 percent of the maximum density as determined by the Standard Proctor Test, ASTM D 698.

6. SAFETY

Dust masks and goggles are recommended to be worn by all personnel on the site during bentonite application and while mixing for protection against bentonite dust.

7. OPERATION AND MAINTENANCE

During hot, dry periods, bentonite treated earth fill liners shall be inspected for drying cracks. Should drying cracks begin to develop, the entire exposed liner area shall be watered. If the bentonite treated earth fill blanket develops major cracks that watering will not heal, the blanket shall be re-mixed and compacted as required in Section 5, Compaction.